THE MEMBERS MAGAZINE OF THE NATURAL HISTORY MUSEUM OF LOS ANGELES COUNTY

Terra

VOL. 17/No. 2 FALL 1978

CURATORS AND COLLECTIONS

ENTOMOLOGY MOVES TO NEW QUARTERS

The Entomology Section has recently occupied its new facilities on the third floor of the Museum's North Wing. The staff is functioning more efficiently as a result of well-organized offices and laboratory immediately adjacent to a large movable module storage system ("Compactor"), custom-built and designed to hold Entomology's large reference collection. The modernized facilities were financed primarily by funds from the Museum Foundation, matching, partly, a sizable grant from the National Science Foundation.

TREES OF TAPEXCO PROJECT A SUCCESS

Curators Julian Donahue, Entomology, and Chris Davidson, Botany, report that the Trees of Tapexco Project was a resounding success. A salvage operation, designed to obtain as many plants and insects as possible from a region of virgin rain forest in Costa Rica which is now in the process of being cleared for agricultural and rangeland uses, netted over fifty-two thousand entomological and 580 botanical specimens. The scientists were assisted in the field by a team of six volunteers through Earthwatch (Center for Field Research), the non-profit granting organization now well-known for its expedition support by involving participating lay persons.

TECUMSEH WAR CLUB

Dick, Jack, and Bill Wall flank their mother, Mabel Wall, who gave Tecumseh club to Museum. Don Chaput in the center.

Shawnee chief Tecumseh, who fell on a Canadian battlefield during the War of 1812, died next to the war club he had used to fight American troops. That war club has been donated to the Museum by descendants of Colonel Garrett Wall, who fought in the battle where Tecumseh died, and who picked up the war club as a souvenir. Donald Chaput, curator of military history, points out that the club is one of the best authenticated artifacts from the War of 1812.

Tecumseh's club, made entirely of wood, is symbolic of the leader's belief that his people should reject the use of metal and other European innovations in favor of returning to traditional Indian life styles. The war club will go on display in the near future.

SAN CLEMENTE ISLAND EXPEDITION

In late August a Museum-sponsored expedition surveyed fossil deposits on San Clemente Island. Participating were Dr. Camm C. Swift, Ichthyology, Dr. Lawrence G. Barnes, Vertebrate Paleontology, Dr. Edward Mitchell, Research Associate, and Michael D. Quarles, Field Associate. Previously-recorded fossil sites were prospected, and fossils eroded out during last winter's heavy rains were collected.

Several large rocks containing fossil whale parts were transported back to the mainland by ship. The specimens, in addition to augmenting our Museum's collections, will be used in publications documenting the fossil record of this interesting California island.

The United States Navy's Naval Ocean Systems Center at San Diego administers the island, and the Natural Resources Program provided support for our trip.

BOLIVIAN FIELD WORK

Dr. Kenneth E. Campbell, Curator of Vertebrate Paleontology at the George C. Page Museum, completed three months of field work in Bolivia this summer. The field work, which involved detailed geological studies, as well as the collecting of vertebrate fossils, was a cooperative project between the Bolivian Geological Survey (Geobol), the Los Angeles County Museum of Natural History, and the University of Florida. It was funded by Geobol and the National Science Foundation. The large number of vertebrate fossils collected will be studied by Bolivian and U.S. scientists, greatly advancing our knowledge of both living and fossil South American vertebrates. Efforts are underway to continue this international cooperative project next year.

JAPANESE PROFESSOR STUDIES "ARK" CLAM SHELL

In late August, Dr. Hiroshi Noda, Professor of Paleontology at the University of Tsukuba in Ibaraki, Japan, spent two days in the Invertebrate Paleontology Section, studying the museum's fossil specimens of the "ark" clam shell *Anadara*. Dr. Noda, a world authority on this

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THE COVER

Funeral Monument. Mboma? *Mica schist. Height 10" (25.4 cm) Found on graves in abandoned cemeteries, the* ntadi *stone statues are often discovered deeply embedded in the earth. Questions about the age and tribal function of this remarkable statuary must be reviewed in the light of the recent extensive discoveries. For example, new evidence suggests that the last sculptors of* ntadi *disappeared as recently as the middle of the twentieth century.*

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A SURVEY OF ZAIRIAN ART

by David E. Baldwin

THE BRONSON COLLECTION

The Natural History Museum of Los Angeles County is currently the host of one of the finest private collections of Zairian traditional art works ever to be publicly displayed in the United States. The works have been collected by the Bronson brothers, Robert and Lee, and Lee's wife, Dona, who have made a serious study of the artistic traditions of the peoples of Central Africa. They have received guidance from Fr. Joseph Cornet (F.S.C.), Director General of the Institute of the National Museums of Zaire.

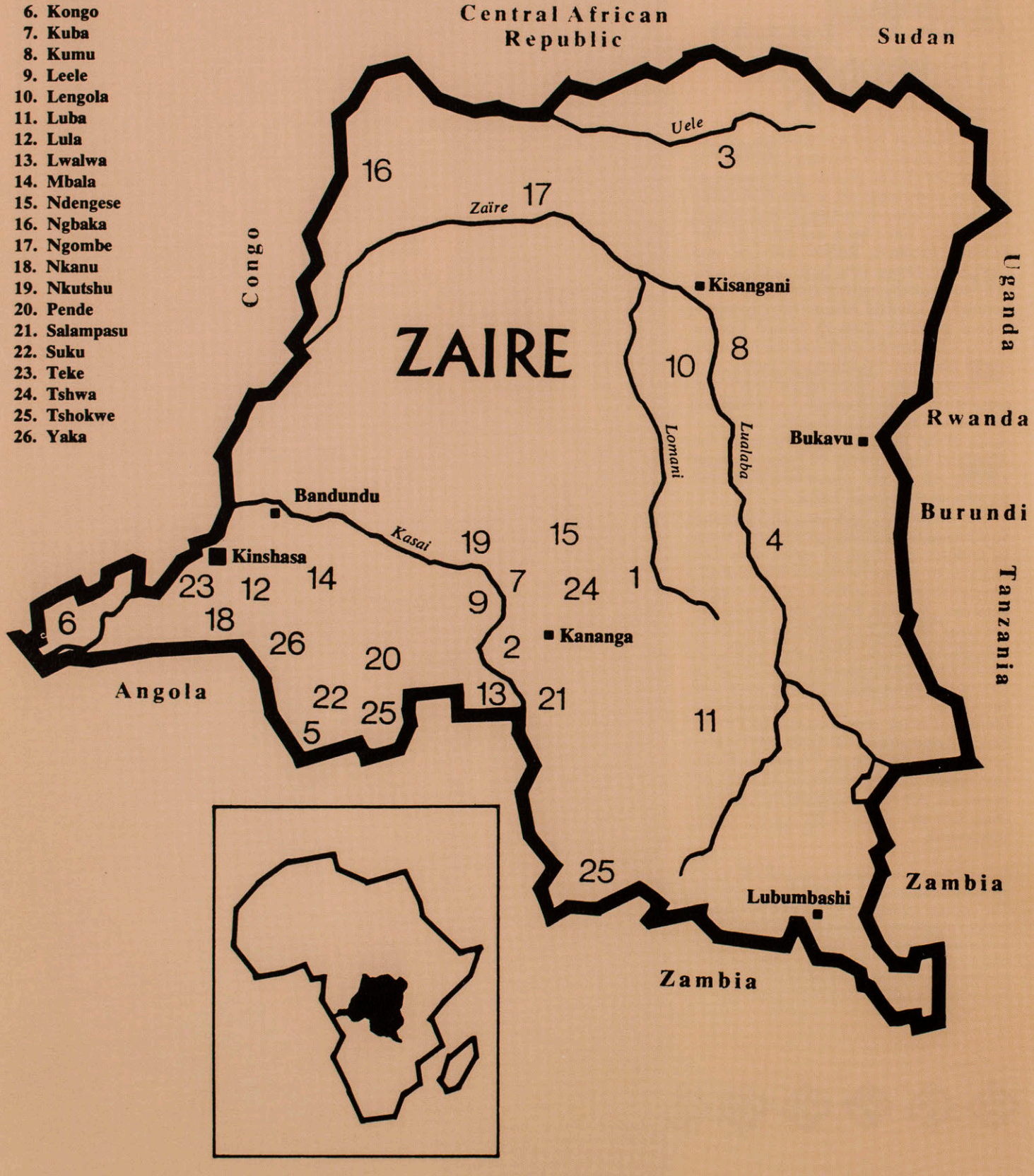
The product of that relationship is the exhibition of the Bronson Collection at the Museum, displayed with the assistance of the National Endowment of the Arts, and highlighting 207 pieces representing all of the major art-producing peoples of the Congo Basin.

The historical, linguistic, and cultural analysis of the populations of Zaire tends to produce an image of uniformity. The analysis of artistic styles, however, demonstrates that there are vast differences between different areas, and that these are areas definable in reference to consistent artistic styles. After only a brief acquaintance with the artistic products of any of the major art-producing people of the Congo Basin, it becomes possible to identify a mask or a statuette as having been produced in a particular style. It is further possible for the expert to divide this region into many dozen distinct expressions. All reasonable divisions, however, can be outlined on an historical framework.

Figure. Yombe. Wood, feathers, nails, fiber, and fetish materials. Height 28" (71.1 cm) The original body adornment and complete surface patina are not commonly found in sculpture of this type. Also noteworthy is the unique feather array headdress with a knitted cap, in contrast to the more common resin cap with embedded vertical feathers.

Peoples of the Republic of Zaire

1. Binji
2. Biombo
3. Boa
4. Hemba
5. Holo
6. Kongo
7. Kuba
8. Kumu
9. Leele
10. Lengola
11. Luba
12. Lula
13. Lwalwa
14. Mbala
15. Ndengese
16. Ngbaka
17. Ngombe
18. Nkanu
19. Nkutshu
20. Pende
21. Salampasu
22. Suku
23. Teke
24. Tshwa
25. Tshokwe
26. Yaka



Zaire is geographically, historically, ethnographically, and artistically massive. It is easy to be overwhelmed and difficult to discern patterns and outlines, structures and relationships, but they do exist. First, of course, Zaire is the former Belgian Congo.

The Congo. The great river and its drainage basin are the dominant geographical facts, dividing the country from the Atlantic Coast to the high mountains of Western Uganda, Rwanda, Burundi, and the great East African lakes. Historically, this land, 1200 miles from the river mouth to the mountains, with deep jungles 700 miles wide, has been of extreme importance. Millions of rains have fallen here, sometimes in excess of 100 inches in a year. The average is over sixty inches in the forest basin and on the slopes of the Ruwenzori Mountains, Ptolemy's Mountains of the Moon. The rains on the eastern slopes eventually flow into the Nile and the Mediterranean; those on the west combine in many hundreds of streams and rivers to become the great river, Stanley's and Conrad's Congo, the modern Zaire River.

It seems probable that the first people to visit Zaire came from the lake country that divides the Nile and the Zaire rivers. We don't know when they came; by seven or eight thousand years ago they were scattered about in the Congo Basin. But we do know who they were. They were the little people, the Pygmies and Bushmen. For many thousands of years they lived their wandering, isolated hunting and gathering, paleolithic lives.

Archaeological and linguistic evidence now seems to show that as early as the fifth century A.D., but no later than the eighth, an altogether new population, taller and stronger, with knowledge of plant cultivation and iron work, and organized into chiefly hierarchies, came migrating down between Lake Victoria and Mount Ruwenzori. These were the true Bantu. Many hints—linguistic, archaeological, oral traditions—point to origins in Northeast Nigeria. We know that they settled in the center of Zaire by the ninth century A.D. This is very compatible country, south of the deep forest: open savannah bordered by forest. From this, the "southern" Bantu heartland, the Bantu-speaking peoples spread through the whole of the Congo Basin.

At the time of European contact, all of the indigenous peoples of Zaire, and all of Africa south of the forest belt, spoke one or another Bantu language, an exception of some Sudanese speakers in the far north and east, the Zande, Mangbetu, and a few neighbors north of the forest. The pygmies all spoke whichever Bantu language was dominant in their area.

Besides this linguistic uniformity, the peoples of this area all had a conception of a high chief or divine king. The degree to which they participated in such a system was variable. The Tetela in the very center of Zaire seem not to have had a kingship of their own; to their south and east the Songye chief's sovereignty was limited to his own village. In the Kwango and most of the lower Kasai regions, kingship was very limited, consisting of at most only a few villages.

The fortunes of most of the inhabitants of the Congo Basin, however, have, at least for the last 500 years, been linked to great centers of power governed by divine kings. It is these centers which have generated the great artistic traditions, the Kongo Kingdom, the Luba and Lunda Empires, and the Kuba Kingdoms.

All the native Zairians, except the pygmies, have a very similar subsistence base: slash and burn shifting agriculture, and New-World-origin crops, manioc, staples since 1500. The older African-origin crops are still important though, and were the subsistence base for these societies before the sixteenth century.

And finally, they all have a fairly uniform set of religious conceptions: one distant high god with numerous messengers sent to earth in the person of the great ancestors. The worship of distant ancestors, and of more recently deceased ones, is combined with an almost universal belief in the power of certain rituals and procedures, and the assumption that natural power can be infused into man-made objects, and that these objects can be efficacious in everything from the prevention of illness to the destruction of an enemy.

Figure. Tabwa? Wood. Height 12" (31.0 cm) This remarkable sculpture almost defies classification. It shows an admittedly vague similarity to a carving in a Brussels collection that is identified as Tabwa.

It is this linguistic, political, and cultural unity that has led most scholars to postulate a single, if distant, point of origin for all the Bantu peoples of the Congo Basin. There is one minority opinion, which sees two avenues of migration into this area, one around the south end of the forest, in the fifth century or so, and another down the coast through the forest somewhat later.

We do know that there was a large population on the shores of Lake Kisale on the headwaters of the River Zaire—the old Congo—in North Central Katanga (now Shaba province) already exploiting the copper deposits by the eighth century.

This is one of the great culture complex centers of Africa. The Luba empire, first recorded in the 1500's, very probably descended from these peoples. In the better recorded history of the last 400 years, we know of a series of movements that have grown out of this Luba center and established themselves as independent cultural centers. An early group apparently traveled as far as the coast and by 1450 had settled on the south banks of the River Zaire, reaching some 300 miles inland. As previously mentioned, these people may have come down directly from the Benue Plateau in Nigeria, but they are in many respects similar to all the Bantu peoples of Zaire.

When Diego Cão reached the mouth of the great river in 1482, he found a large kingdom extending south 125 miles from the River Zaire to the Loje, and 350 miles inland to the Kwango River. This was the Kongo Kingdom. The Teke, 350 miles upriver and concentrated on the north bank, and the Woyo and Vili were related to the Kongo.

Although relations between the Kongo kings and the Portuguese started well, by 1550 internal pressures had started to loosen the foundation of the Kongo Empire, and in 1560 the king of the Kongo was overthrown by a warrior horde called the Jaga. Today the influence of this great political entity still lies over all of the peoples of the lower river. It seems reasonable to think of the Yombe, Kongo-BaBoma, and Mboma as being their descendants.

One artistic tradition from the southeastern quarter of this region, which is remarkable mostly because of its divergence from the general characteristics of Zairian sculpture, is represented by the little steatite figures, twelve to twenty inches high, called Ntadi, mostly found in the vicinity of Matadi. Historically, it is significant that we have a record of four of these pieces being brought to Rome prior to 1670.

Approximately contemporaneous with the flowering of the Kongo, the modern Luba nation was first becoming a significant force in what is now southeastern Zaire in the Bantu heartland.

One of the flaws in the political organization of these people, indeed of all the great West African political systems, is that they have never resolved the problem of the transfer of authority when a king dies. When a throne becomes vacant, there is almost always a lengthy interregnum during which towns on the border of the kingdom find it convenient and possible to become independent. Thus, in every generation there is a budding of new mini-kingdoms, which have the potential of becoming important groups.

The Luba spawned the Bemba, Hemba, and Songye off to the north in the 1500's. Somewhat later, in the early years of the seventeenth century, a disaffected segment of the Luba royal family became the rulers of the Lunda to the south and west of the Luba homeland. They then generated the Luena, Songo, Jaga, and Tshokwe. These last two are especially significant for an understanding of Zairian art.

During the early Luba-Lunda expansion, indigenous bands of well-organized warriors separated from the parent group and swept across broad reaches of land, founding new dynasties. The first of these was the Jaga, in the 1560's, a small well-disciplined cadre of wanderers who moved off west and devastated much of the territory claimed by the Kongo. When they settled, they set up their own small kingdoms, the most important and lasting of which is the Yaka, with their spinoffs, the Suku and Holo.

Again, at the beginning of the eighteenth century, when the Luba-Lunda states were at their height, they had to contend with and eventually accommodate a powerful group of well-armed traders who settled on their southern border, the Tshokwe. Actually, the ancestral Tshokwe had probably budded off the Lunda to the south sometime prior to 1700, but they remained a relatively isolated and geographically quite limited society until 1850. Throughout their settled period they had become renowned traders, gradually spreading their influence. After 1850, with superior organization and newer firearms, they became the rulers over the whole of North Angola and much of south central Zaire.

The final major political and artistic center to become established in the southern half of Zaire was the Kuba. Kuba is the name applied by their neighbors to a group of some eighteen closely-allied groups dominated by the royal lineage, the Bushongo. Apparently they migrated into their present homeland, on the middle Kasai River, in the early years of the seventeenth century. Probably they are of distant Luba stock who touched the Kongo people on their way, and absorbed some of their traditions. Once they found the crook of the Kasai and Sankuru Rivers, in the very center of the southern half of Zaire, they established one of the most stable political and cultural systems in all of Central Africa. The population grew, trade developed, and craftsmen, then great artists, became the focus for that society. The Kuba remain today a state, remarkable for their material prosperity and high standard of living.

This, then, represents an outline of the peopling of the Zairian savannah south of the dense forest. There are a few art-producing Bantu peoples in the forest, mostly in the east, but their production is as limited as our knowledge of their histories. Probably they are recent, and surely they are related to the Luba, though it could be that they represent a later wave of migrants from the north. The two most important groups here are the Lega and Lengola.

Mask. Yaka. Wood, cloth, fiber, and polychrome. Height approximately 31-1/2" (80.0 cm) Generally the masks are used only once and are burned after the ceremony. The animal represented on the superstructure is a varan, a rare and, for the Yaka, very mysterious lizard used by the fetish priest in preparing magical ingredients.

It can never be overemphasized that there is a fundamental difference in the way a participant in a culture reacts to a carving from his culture and the way an alien reacts to that same piece. Westerners, or any non-participants, appreciate art in terms of purely aesthetic considerations. The producers of these works, however, are concerned not with the object as art only, though this is of much more importance than even recently realized, but as a functioning part of a complex cultural system. The function of the piece is as important as its structure. In their home, in their primary cultural matrix, these objects are imbued with an effectiveness that is one overwhelming part of their existence. For generations the cultural power behind traditional art was denigrated or ignored. Now we are trying to recapture some of that. The first requirement is to place these pieces in their context and then to have as full as possible an understanding of that context.

Fr. Joseph Cornet has written that "in order to understand and enjoy these works of art, it is essential that they should be grouped and classified with the contexts of usage, society, and religion."

With this monumental organization of the works in the Bronson Collection and the new synthesis of the peoples of Zaire Fr. Cornet has composed a magnificent 375-page catalog of the exhibit with which he has led us to a fuller understanding of that context. Significantly he has departed from the old standard of speaking of regions and regional differences as if they were static and bounded entities. Rather he asks us to see a pattern of interconnected centers of artistic influence, which are, at their centers, quite characteristic and distinct, but which blend and meld together on the borders in a fascinating and almost endlessly complex mosaic.

Mask. Songye. Wood. Height 14-3/4" (37.5 cm) During the past fifteen years, fewer than ten masks of this type have been seen that are comparable to this example with evidence of tribal usage and approximate age of forty years or more.

Figure. Hemba. Wood and cloth. Height 27-2/3" (69.5 cm) A singiti *or ancestral statue, this work was traditionally kept by chiefs and elders in huts used only to protect the statues. It is from the chiefdom of the Bena Niembo in the Sayi Region.*

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David Baldwin is a volunteer researcher with the Anthropology Section of the Natural History Museum. A doctoral candidate in Anthropology at the University of Chicago, Baldwin's special interest is West African ceremonial art, particularly masks.

Chief's Staff. Luba. Wood and metal. Length overall 58-1/2" (148.5 cm) Height of figures 6-2/3" (17.0 cm) The finial represents two female figures, each with one hand on the other's back and one hand on its own shoulder. According to the customary style, the heads have high foreheads, and the eyes are carved in slight relief.

Box. Kuba. Wood. Length 11" (27.9 cm) Width approximately 6" (15.2 cm) In rare cases, boxes for red powder are carved in the form of a mask, with the facial features sculptured in relief on the cover. The hairline and attached nose and mouth of this box clearly indicate Kuba art.

The exhibition, *A Survey of Zairian Art: The Bronson Collection,* was designed and installed at the Natural History Museum of Los Angeles County by Dona Bronson.

Mask. Salampasu. Wood and copper. Height 12-1/4" (31.0 cm) Recognized style elements of Salampasu wooden masks include an extremely convex forehead shadowing a thin eyeline, a triangular nose, and a square mouth with pointed teeth painted white.

Pelicans from a nineteenth century French engraving.

THE ECLECTIC PELICAN

by Elizabeth A. & Ralph W. Schreiber

Elizabeth and Ralph Schreiber have arranged an exhibit called The Eclectic Pelican in the Second Floor changing gallery of the Natural History Museum of Los Angeles County, starting December 6 and continuing through March 30, 1979. The exhibit initiates a fund-raising campaign to refurbish and add to the displays in the Museum's Bird Hall. Teri Matelson, of Santa Barbara, had drawn two interpretations of the pelican for the Museum. One is the comical, ungainly, larger-than-life pelican illustrated in the accompanying article, to be a poster for the exhibit. The other is a study of four pelicans, which will be a limited edition of lithographs, signed and numbered. Both will be sold to benefit the fund-raising project.

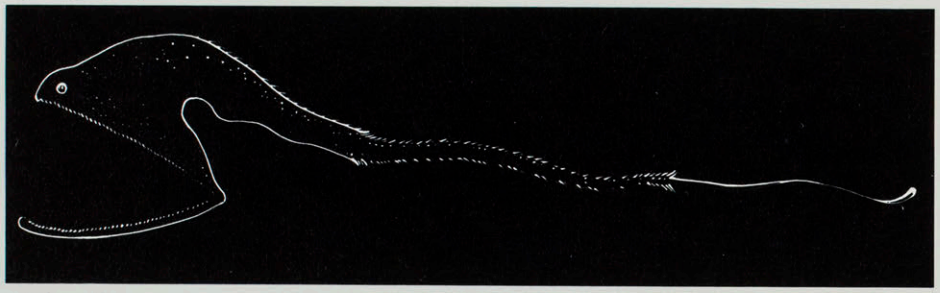
Since the earliest days of recorded history, the characteristics and mannerisms of pelicans have impressed, interested, amazed and fascinated man. Pelicans have long been associated with religious symbolism and with legends. Because some pelicans of Europe and North Africa inhabited desolate areas, they became a symbol of loneliness and unhappiness in the psalms and prophecies of the Israelites.

Early Christians used the pelican to symbolize the crucifixion. The pelican is also referred to in Psalm 102:6, written long before Christ: "I am like a pelican in the Wilderness." As with other symbols, the pelican was portrayed in stained glass windows and mosaics, in wood and stone, and pictured on sacred vessels. From the thirteenth to fifteenth centuries early naturalists promoted the legend of the pelican by attributing the red tip at the end of the beak to blood drawn from the pelican's own heart to feed its young during periods of famine. This is why the pelican is a symbol of Christ's sacrifice and the Eucharist.

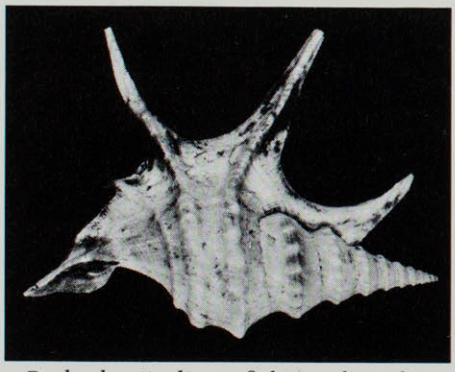
The medieval book, *Bestiary,* tells us that the pelican parents love their young, but as soon as the nestlings mature, they violently turn against the male parent, causing him to kill them. The story goes on that within three days the female returns to the nest, whereupon she pours her blood over the nestlings, reviving them.

An aquatic bird, the pelican is often associated with the sea. Many famous ships have been named after these far-flying birds. One such sailing vessel was christened the *Pelican,* only to be renamed the *Golden Hind* by the Englishman, Sir Francis Drake, who achieved fame by circumnavigating the globe on her. Pelican class sail boats are especially popular on the rough waters of San Francisco Bay.

In more recent times two unusual sea creatures have been given the name pelican because of their physical peculiarities. One of these, the "pelican fish," is a gulper eel with a long, slender body that may extend well over six feet in length, and an enormous mouth and stomach which easily distend, suggesting the pouch of a pelican. This enlargement enables the deep sea pelican fish to goggle up large prey.



The other sea creature is a rather small marine snail commonly known as a "pelican foot." This said-to-be edible animal received its name from the distribution of spines that extend from the shell. The spines suggest the webbed toes of a pelican. (The *whole* thing resembles a pelican foot.)



Both the "pelican fish" and "pelican foot" mollusk are on display in the Eclectic Pelican exhibit because of these interesting resemblances.

Two islands in the continental waters of the United States are also named after the pelican. One is located in the Indian River on the east coast of Florida. This island received its name because of the large population of Brown Pelicans that breed there. In 1903, Pelican Island became the first national Wildlife Refuge in this country.

The other more famous—actually infamous—island is Alcatraz in San Francisco Bay. *Alcatraz* is Spanish for pelican and the prisoners who were incarcerated on this rocky, water-buffeted island may have enviously eyed the freedom of the pelicans as they soared over the penitentiary.

The popularity of the pelican in the Gulf regions of the United States, led Louisiana to portray the bird on its automobile license plates for many years. The Brown Pelican remains the Louisiana state bird, and is depicted on the Great Seal of that state. It also appears on the seal of the City of St. Petersburg, Florida.

The symbol of these birds has become increasingly commercial. Twisted neon signs forming pelicans blink on and off beckoning people to eat, sleep, and live in restaurants, motels, hotels, and housing developments.

There is a city named Pelican Rapids in Minnesota, the endangered Brown Pelican appeared on an eight-cent Wildlife Conservation stamp, a pelican punch herb tea is manufactured, and a charming young Hollywood actress is named Lisa Pelikan. Surely pelicans of the world deserve their Eclectic Pelican showing in the Natural History Museum!

Dr. Ralph W. Schreiber, curator of ornithology at the Natural History Museum of Los Angeles County, has, with his wife, Elizabeth, a Research Associate at the Museum, spent a decade studying the biology of pelicans.

TYRANNOSAURUS REX AND THE AMATEURS

How a plumber, some housewives, and a handful of high school students hunted down and restored the largest Tyrannosaurus skull ever found.

by Mary Odano
Photographs by Harley Garbani and Larry Reynolds
Drawings by John Dawson

"Tyrannosaurus rex — *why don't we have a specimen of* Tyrannosaurus rex?"

I must admit my imagination was fired that day in 1965, when I heard Mr. William Sesnon, a member of the Board of Governors of our museum, ask that question of Dr. Reid Macdonald, our Senior Curator of Vertebrate Paleontology.

Dr. Macdonald quickly replied that while *Tyrannosaurus rex* was probably the most famous of the dinosaurs, and any small boy or girl could tell you all about him, he was also one of the rarest.

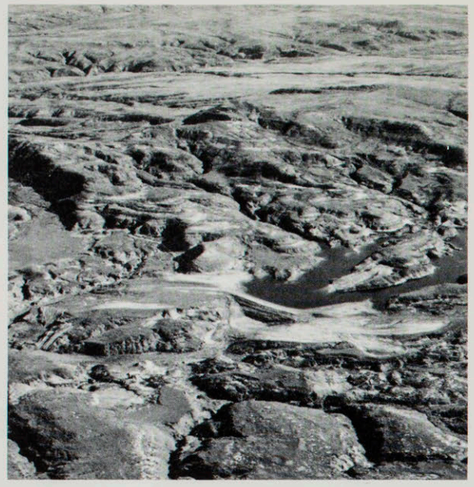
The first and second specimens were both found around the turn of the century by Barnum Brown and his party from the American Museum of Natural History. They were looking for fossils in the Hell Creek area of Montana when they came across this great carnivorous beast. The second of the two finds was the most complete skull and skeleton ever uncovered to date. Today, it is a prime attraction at the Museum in New York City. Since then, other remains had been found, but at best they were scattered, miscellaneous bones. In all, there were in 1965 fewer than a dozen recorded specimens.

"Your chances of finding anything like the American Museum skeleton are about as good as winning a million at Las Vegas, Mr. Sesnon. Are you willing to gamble?"

Mr. Sesnon was not anxious to wager huge sums on such a remote possibility, but he did agree to provide enough money to send a field party to Montana for three summers. So preparations for the hunt began at once.

The best fossil prospector known to the museum was Harley Garbani of San Jacinto, California. Harley was a plumber by trade, but escaped to the surrounding countryside as often as he could to indulge himself in his favorite hobby, fossil collecting. For many years he had supplied the museum with fossils from many localities.

When he heard of the proposed three-year search for *T. rex,* Harley was easily persuaded to head the expedition. The party that would accompany him included his wife Vi, their daughter Charlotte, and Steve Wright, a member of the High School Workshop at our museum. Thus, every member of this important expedition was an amateur — but they were amateurs animated by a great



The rugged ranchlands of Garfield County, Montana had already yielded two great Tyrannosaurus *skulls in the early part of this century. In 1966, the Natural History Museum of Los Angeles County decided to try the same area once again.*

enthusiasm for paleontology, and possessing a truly professional attitude about their work.

Harley was more than eager to get started, but there was one problem. His past discoveries had been almost exclusively mammals — horses, camels, sloths, dire wolves, and mammoths. What, he wondered, did the bones of *T. rex* look like? The museum had no collection that could show him their size and shape, so the best we could do was find books containing illustrations of the bones and duplicate them for Harley to take to the field — not the ideal solution, but the only one we had.

The logical place for Harley to prospect was the same area in Montana where Brown had made his finds almost seventy years before. For two years, Harley scoured the cattle range badlands of Garfield County. He found many fascinating creatures — the skull cap of *Pachycephalosaurus* (a thick-skulled herbivorous dinosaur), two huge adult duckbill dinosaurs and one juvenile, some *Triceratops* skulls, assorted crocodiles and turtles, Cretaceous mammals with mouse-size jaws and teeth — but no *T. rex.*

From the beginning, the inside joke in the party was that *T. rex* would not be found until the last week of the third summer that Mr. Sesnon had agreed to finance. But during the third summer, as this possibility became nearly a reality, anxiety began to grow. What if *T. rex* didn't show at all? Although it was true that the dinosaur specimens found to date had more than made the trip worthwhile, the disappointment of not finding the big prize would have been very great.

Harley covered most of Garfield County following leads from the local ranchers. He spent Saturday nights in the small town bars of Jordan, the county seat, talking to curious ranchers who wanted to be helpful. They told Harley about bones they'd seen on their ranches, and almost every sighting was followed up. Harley made many friends for himself and for the museum among these lonely, hardy people, with his friendly banter and his constant respect for their property . . . but no *T. rex.*

Meantime, a team of boys from the Museum High School Workshop had joined the field party. They labored to uncover the bones already found by Harley and ship them to the museum while he continued to prospect for the big one. From time to time, hope was fanned by the discovery of an isolated tooth. But it was beginning to look as though *T-rex* himself was simply not going to turn up.

Then, on a hot afternoon in late August, 1968, Harley saw a toe bone — a *big* toe bone — protruding from the wall of a gully. It might just be big enough, he thought, to be a toe from the giant foot of *Tyrannosaurus.*

Harley carefully scraped away the surface of the ground for several feet around, digging down into the soil inch by inch. More and more bones began to appear. A huge vertebra, more toe bones, ribs, and mudholes with strange pieces of broken bone — all seemed to be leading into the gully wall.

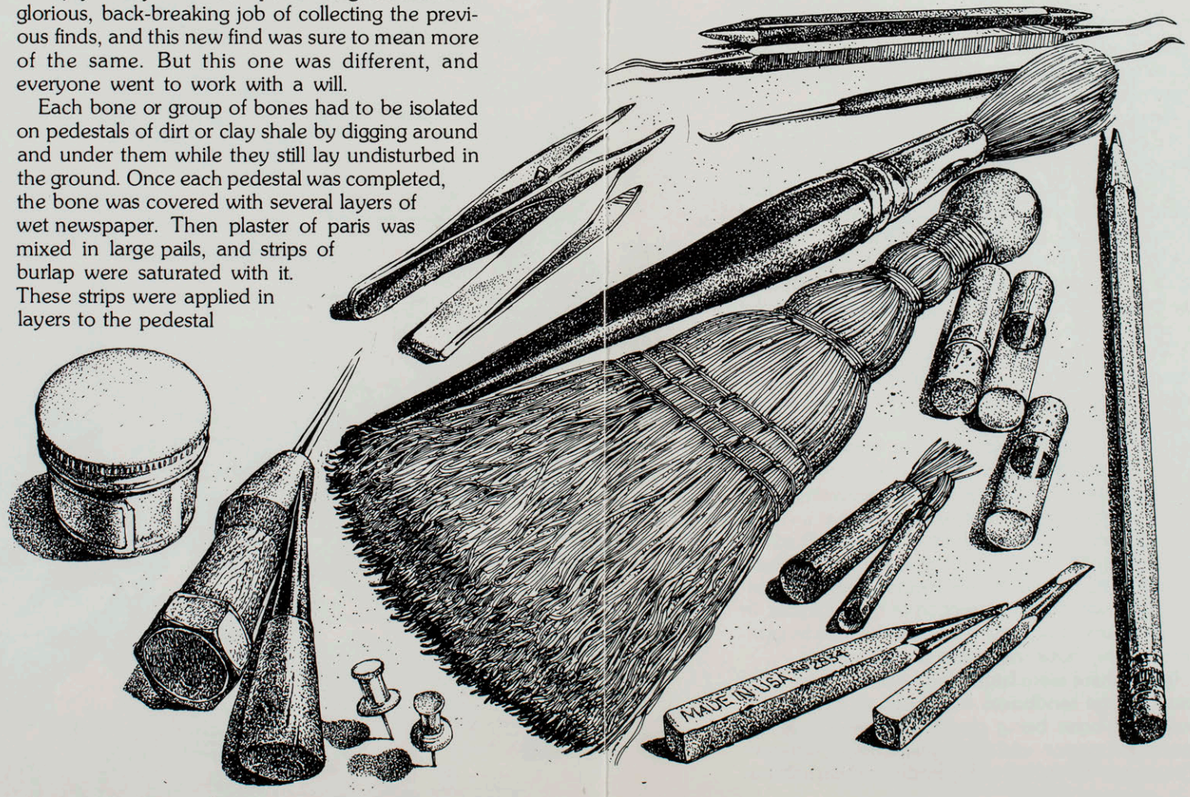
Harley was not entirely certain he had scored. But, filled with excitement, he hastened fifteen miles to town over the rough dirt roads to call Macdonald in Los Angeles. Normally, a trip to town was made once a week to restock food, gas, and other supplies — but Harley was not about to wait. From the description of the bones that Harley gave, Macdonald agreed that it sounded like *T. rex,* and the tension and excitement began to grow among the staff members at the museum.

The field party, now consisting of Mike Grey, Sue Haley, and Steven Odano, were beside themselves with joy. They had been performing the not-too-glorious, back-breaking job of collecting the previous finds, and this new find was sure to mean more of the same. But this one was different, and everyone went to work with a will.

Each bone or group of bones had to be isolated on pedestals of dirt or clay shale by digging around and under them while they still lay undisturbed in the ground. Once each pedestal was completed, the bone was covered with several layers of wet newspaper. Then plaster of paris was mixed in large pails, and strips of burlap were saturated with it. These strips were applied in layers to the pedestal and the newspaper-covered bone. Once the plaster was dry and hard, the pedestal was cut, the block turned over, and the other side plastered. Thus the bone would be well-protected against damage during the long trip home to Los Angeles. Fragments of bones and bones pulled out of the mud-holes were put in bags and given numbers. The numbers were then written on a diagram of the dig, showing where each of the fragments had been found. All activity meaningful to the history of the dig was entered in a log book.

The bones found thus far indicated that this was indeed a huge carnivorous reptile. But no parts of a skull had been found, and so it was difficult to make a positive identification. The bone bed led back into the gully wall, and to remove the hard overlying material by hand would take more time than there was — a chill in the air was already signalling the imminent arrival of winter. The son of the ranch owner agreed to bring in a bulldozer, which would save the diggers many days of back-breaking work. Afterwards, the boys could excavate with small tools and paint brushes.

Several days later a huge jaw came to view. This was a day of celebration — but the party's joy was quickly quenched by the first snow flurries of September. The jaw was hastily excavated. The ground containing the rest of the bone was covered over with plastic sheets and dirt, to protect it as much as possible against snow damage until work could resume the following summer.



The first part of the skull to be found was the gigantic jaw with its rows of beautifully preserved teeth. It was a year later before the field party was able to find the remainder of the skull nearby.

Filled with satisfaction and hoping to get everyone together again the following June, the party drove their field trucks back to Los Angeles, bringing *T. rex's* jaw, their prize trophy, with them.

At the museum, a small crowd of eager people had gathered to welcome them. The plaster jacket was unloaded with great care, and opened immediately. Filled with the enthusiasm and curiosity, I worked overtime Saturdays and Sundays cleaning all the dirt and clay from the huge teeth and the two other bones in the jacket. This naturally required meticulous care. I used very small dental picks, chisels, paint brushes, awls, and tweezers to remove the matrix — or surrounding rock — from the bone. Broken bones had to be glued back in their proper places with white glue. Pieces too small to fit together were hardened in place with thin glue that was absorbed by the matrix between the pieces. Often, I had to fill cracks with glue or polyester resin before the bone could be removed from the matrix.

Finally, all three bones were shining and sturdy. Working with a set of illustrations of the American Museum specimens, we tried to identify the pieces. I learned that many of the bones of reptile skulls are joined with movable joints instead of the rigid joints or sutures characteristic of mammal skulls. The correct matching of these joints was not apparent. But it was easy to identify the dentary (the tooth-bearing part of the jaw), as well as the surangular bone (a large plate-like bone that forms the upper part of the back of the jaw).

There was however, a third bone no one could quite identify. It was large and sub-triangular. A portion was broken off the top, but how much no one knew. Since it was found under the jaw, we assumed it went with it. From the illustrations we had, in fact, it looked a lot like the half-hidden angular bone of the lower jaw. We were not quite satisfied that it was the angular bone, but we positioned it below the surangular and continued to ready the jaw for exhibit. Three years later, when we were looking for the second jugal — a cheek bone — we discovered that this jugal was our third bone!

The bones of the upper part of the skull were so scattered and jumbled in the ground that it was not considered wise to try removing them in the field. Instead, the entire block of earth containing them was jacketed in plaster and shipped by trailer truck back to the museum.

The next summer, Harley, Kent Valmassey, Greg Macdonald, Mike Gray and Frank Bain returned to Montana. The ranch on which the bones had been found was now a local point of interest. The word travelled around Garfield County that the Natural History Museum field party had found a *Tyrannosaurus rex.* The fact that the dig was in the middle of a ranch with only cross-country access — via four-wheel drive truck or on horseback — was no deterrent to visitors. The countryside had been vacant the previous summers, but now the dig had plenty of onlookers, who sometimes lent a welcome helping hand.

With a cheering section to spur them on, Harley and the boys searched for the rest of the skull and whatever other bones might still be buried there. It soon became apparent that the bulldozer would be necessary again, because the bones were still lodged deep in the side of the gully with tons of earth on top. The ranch owner's son obliged us again. Each pass of the bulldozer was watched closely to detect any showing of bone. If the blade came down one inch too far, it could scrape precious bone material into a heap of fragments by the end of its run.

The diggers watched nervously until the layer of bone was reached. Then they tackled the job of patiently uncovering, by hand, the bones buried there. Soon, to everyone's delight, it became apparent that there were many skull bones present. At the same time, it also became obvious that this skull was not going to be found intact as the one at the American Museum had been. It was scattered over a large area, about eight feet long by twelve feet wide (2.4 meters by 3.6 meters).

It was a tremendous job to plaster-jacket such a large piece of earth and shore it up with timber so it would not bend and damage the contents. Other plaster blocks were constructed for the vertebrae, ribs, feet, and parts of the pelvis. These were all loaded into a semi-trailer truck and transported to Los Angeles.

Montana had yielded its third great *Tyrannosaurus rex.*

Since the great skull block was too large and too heavy to be transported by freight elevator to the fourth floor preparation lab at the museum, it and the other blocks were deposited in a warehouse nearby.

I began work immediately, receiving a great deal of help from museum volunteers Lenor Raub, Jean McKibbin, and Joan Schlegel. They were all housewives who had called the museum to volunteer their services. Lenor and Joan had children interested in fossils, and were initially drawn to the museum through them. Jean had come to the museum on some other business, and seeing us chiseling rock away from some fossils, had become entranced with the idea of doing it herself.

The plaster blocks looked like formidable white monsters in the dimly lit warehouse. One of our first purchases was a saber saw, which we used to cut all around the tops of the jackets. We lifted the tops off like lids, and inside was all the bone and dirt exactly as it had been in Montana.

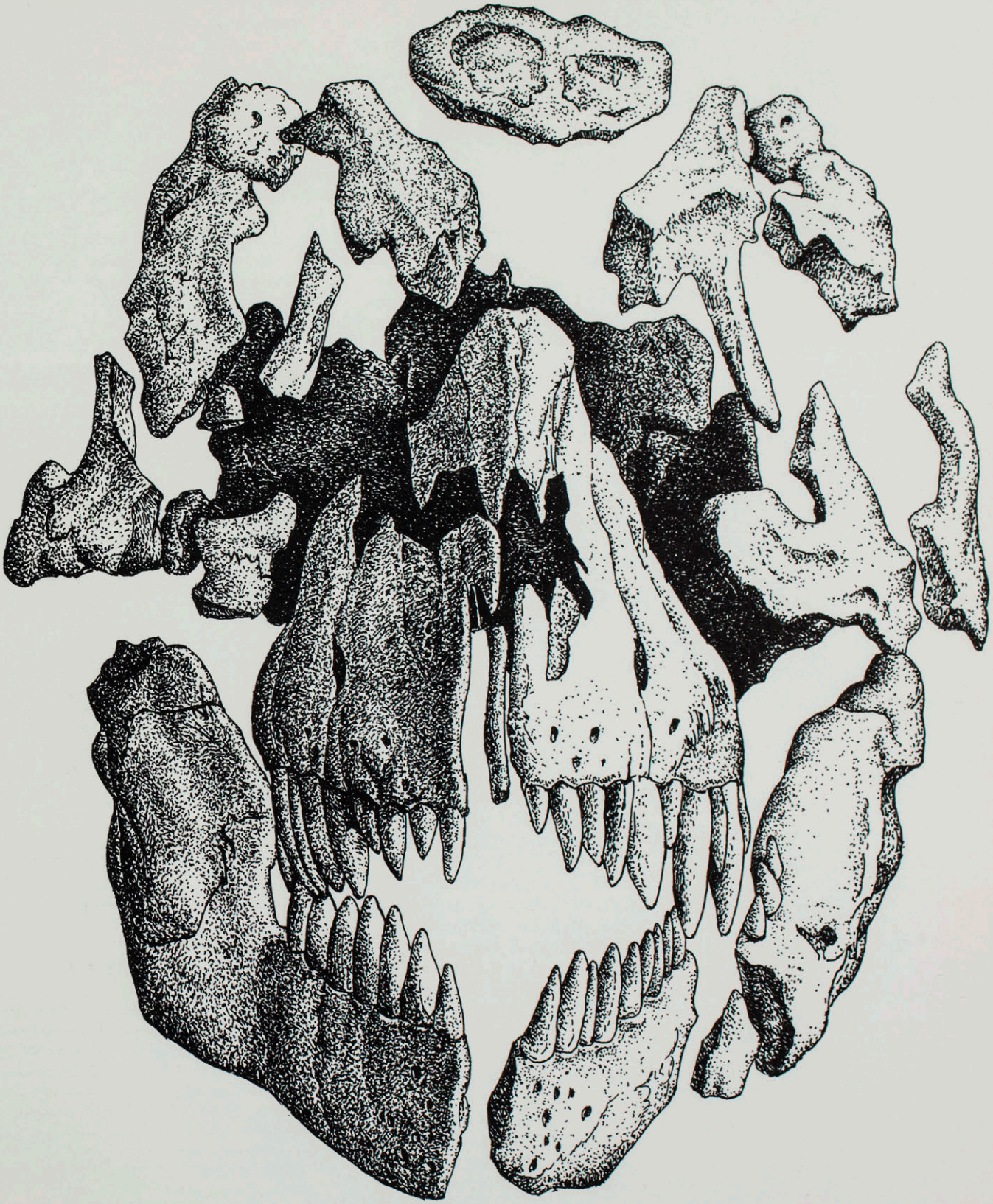
We worked in the cold warehouse throughout the winter of 1969-70, under rather trying conditions. This warehouse was also a repository for the carcasses of whales waiting to be skeletonized. The stench of the drying whaleflesh was sometimes incredible. There were also colonies of dermestid beetles which ate the drying flesh, and literally thousands of black widow spiders that preyed on the dermestids. So it took some determination to keep working away with our little dental tools and brushes.

The huge eight-by-twelve block was too large to reach across from the sides, so we found ourselves sitting inside the jacket, filling tin cans with the clay shale waste as we chipped it away.

Our ignorance of exact shapes forced us to work with extreme caution. Henry Fairfield Osborn's paper on the *Tyrannosaurus* was excellent help, but the great skull at the American Museum had never been completely taken apart and described in detail, so we had no exact guide. We referred constantly to the illustrations of the skull and to other publications on *Allosaurus,* which was possibly the ancestor of *T. rex* and consequently similar in construction.

We cleaned the sturdier broken bones thoroughly and glued them back together as we removed them from the matrix. When this was not possible, as in the case of certain interwoven bones, we drew diagrams and gave the bones numbers which were to be used as a guide when we assembled them later. The only hope of recovering some of the longer, thinner, more delicate bones — some crushed into hundreds of small pieces but still in place — was to harden with glue the matrix of dirt between the mosaic of little pieces. Then we carefully removed the entire section of matrix. Later, in the museum laboratory, we would be able to extricate the tiny bone fragments one at a time.

When there were larger and heavier bones to be joined, large sandboxes were used to support the pieces of bone being glued. The sand held the pieces in position while the glue slowly hardened. Thousands of fits had to be made, and each fit had



Harley Garbani, although an amateur, was considered the best vertebrate fossil finder that could be found. Since his discovery of the largest T. rex skull ever collected, he has become a full-time fossil hunter, working professionally for various museums. Mary Odano, author of this article, has also become a distinguished professional, and is now a Preparator for the Natural History Museum of Los Angeles County.

to be as perfect as possible or the final product would be distorted.

After many months in the warehouse, we were finally able to leave our chilly purgatory and transport the bones to the museum for further preparation. All of our work had resulted in thirty beautifully sculptured pieces of fossil skull. The problem now was to fit all of them together to actually form a skull.

The position of the bones in the block didn't help much — they were too scattered. A cast of the *T. rex* skull in New York was obtained, and along with Osborn's paper, it was of great help. But on the cast and in the drawings many of the bones were obscured by the overlapping structures. Some of them I could figure out — the bones with teeth were easy — but others defied my imagination.

Since no comparative collection of dinosaurs existed at our museum, we now needed someone to help us who had seen a lot of carnivorous dinosaurs. We decided to ask the Zoology Department at the Los Angeles campus of the University of California for a graduate student who might possibly fill the bill.

Dr. Everett Olson, chairman of the department and a world-renowned paleontologist, put us in touch with Ralph Molnar, a graduate student in Zoology who was looking for a suitable project for his doctoral thesis. Ralph had been to all the major museums in the United States and had studied many of the carnosaur remains found in this country. He gladly came to look over our specimens, and they proved to be as exciting to him as they were to us. The immediate task of identifying each bone became the object of his research.

Ralph's identifications indicated that we had about two-thirds of the cranium and almost all the elements for both lower jaws. All that was missing for a complete set of jaws were two very thin bones on the inner surfaces, and even they were represented by fragments.

Ralph came crosstown from UCLA several days a week to engineer the assembling of the huge reptile skull. He designed a rough base of styrofoam, and we began to attach the bones we had positively identified. They were secured with wire rods and wood dowels which were punched into the foam.

The fact that we did not have all the bones of the skull was by no means a disaster. It's very unusual to find a complete skeleton of any fossil animal. When a fossil animal is to be displayed to the public, the museum preparators must usually make up many missing parts. In this case, we were fortunate to have all the elements of the skull represented on one side or the other, so each missing piece could be made in the mirror image of its real counterpart. The duplicate parts were carved from styrofoam and textured like bone, then painted to blend with the real fossils.

Since carving is not easy, this took a lot of time. Modelling in clay would have saved us time, but we were concerned about the weight of the completed skull, so light styrofoam was better. While I was busy carving and preparing the new "bones," Ralph was researching the next steps for assembly.

Earlier, I mentioned the overlapping sutures which could slide a bit to give the skull mobility in life. These structures were of a very thin bone that proved most difficult to fit properly. During the seventy million years that the bones had lain in the earth, some of them had been deformed by the weight of the rock and soil which covered them. We were sometimes forced to carefully break and reassemble these bones to change the angle a little.

The exacting work of restoration proceeded day after day, week after week. We had to work very slowly and carefully, but we were enjoying ourselves so much that time flew by. Before we knew it, more than a year had passed.

At last, all the bones were fitted on the base, and the skull looked most impressive. It was huge — almost four and a half feet (134.6 centimeters) from the tip of the snout to the crest at the back. It was two inches longer than the specimen in the American Museum. The serrated, fang-like teeth extended five inches beyond the bone of the upper jaw.

We had our Tyrannosaurus. There he was in our preparation lab, looking fierce . . . and awesome . . . and beautiful.

To Our Readers

The successful collection of a vertebrate fossil described in this article was done by amateurs ***working in cooperation with a recognized scientific institution and under the supervision of professional paleontologists.*** *We want to strongly discourage our readers from attempting to collect vertebrate fossils on their own. A great deal of valuable vertebrate fossil material has been forever lost to science because the collector did not know how to properly collect it, or did not report it to the professional scientific community. If you do discover vertebrate remains in the course of your collecting, we urge you to report it immediately to a professional paleontologist. In all probability, you will still get to assist in the collection of the material, you will learn a great deal in the process . . . and you may be making an important contribution to science.*

(continued from page 2)

clam, is searching for missing links in its ancestry and is giving technical advice to businessmen who "farm" the clam as an important human food resource in Japan. We loaned him 7,332 specimens to use in Japan for further study.

GEM MINES OF MINAS GERAIS, BRAZIL

Dr. Peter Keller, Curator of Mineralogy and Geology, took an August trip to the gem mining areas of Minas Gerais, Brazil, as part of the Museum's "Minerals to Gems in the Americas" project. The primary purpose of the project is to acquire fine gem crystals for exhibit in the new Hall of Gems and Minerals, as well as to produce a film on Gems. The film will tell the entire story of a gem, from its formation to its occurrence, to its mining and use.

While in Brazil, Dr. Keller visited the Imperial Topaz mines near Ouro Preto, and numerous tourmaline, beryl, and kunzite bearing pegmatites in the Governador Valadares area of Minas Gerais. Especially exciting were visits to the Cruziero Mine (the mine that produced the spectacular elbaite tourmaline displayed in the entrance to the new Mineral Hall), the Golconda Mine, and the Boa Vista phosphate-bearing pegmatite.

The trip yielded fine specimens for the Museum's study collection, two rubellite tourmaline specimens for display in the new Mineral Hall, and necessary information to begin production of the film.

INDEX OF AMERICAN DESIGN

The History Division has acquired color slides and information on more than 1200 artist's renderings from the California Index of American Design. The museum is one of only three institutions in the state with complete sets of this 1936–1941 W.P.A. project. The Index, an important research tool in the study of California historical artifacts from the seventeenth to the twentieth century, covers such diverse categories as textiles, furniture, architecture, costumes, carvings, metal, dolls, glass, and ceramics.

CALIFORNIA MINERAL COLLECTING

Dr. Anthony R. Kampf, Associate Curator of Mineralogy, made two summer collecting trips to California mineral localities, accompanied by Charles Freed, President of the Mineralogical Society of Southern California, and Mrs. Constance Pearson, Mineralogy volunteer.

The first trip, to mineral-rich San Benito County, secured specimens of artinite, neptunite, benitoite, melanite garnet, and magnetite. The second trip, to the well-known Champion Mine in Mono County, produced fine specimens of rutile as well as rare phosphate minerals for research.

RARE PLANT COLLECTING IN HAWAII

Robert Gustafson led a successful field trip to Maui & Hawaii during July. The nine-person team found many rare and endangered plant species which are rapidly disappearing from the islands. Museum docents Frances Runyan and Betty Birdsall participated in the field trip and were of great assistance in collecting valuable plant material.

CIVIL WAR LAP DESK

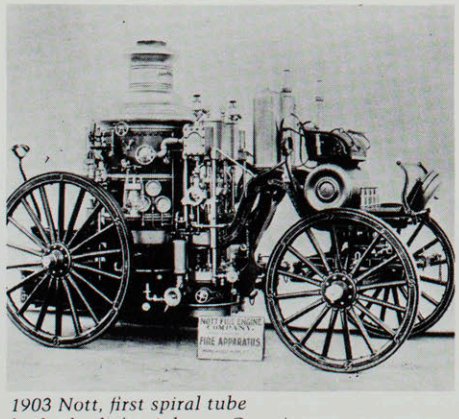
An officer's campaign lap desk has recently been donated to the History Division. Lt. Jonathan Miller of the First Illinois Artillery Regiment carried the finely-crafted hardwood lap desk with him during the Civil War. Donated by a friend of Lt. Miller's last direct descendant who had come into possession of the piece, the lap desk contained a number of items that belonged to the original owner. These insignia, personal papers, and military commission papers have been added to the History collections of Civil War documents and other memorabilia.

FIRE PUMPER RESTORATION

The 1904 Nott fire pumper, formerly used by the Los Angeles Fire Department and Paramount Studios (as a movie prop) is being restored by the History Division. Jim Anderson, Brian Woolsey, and Jim Zordich are reassembling about 1500 already restored parts. Each one has been treated with one or more processes such as sandblasting, filling, sanding, priming, painting, nickel plating, gold leafing, and pinstriping. When put back together, the fire pump will be returned to its original condition.

The Nott engine, along with some one thousand other historical artifacts, will be on display in the Lando Hall of California and Southwest History.

The pumper was the standard and longtime equipment of Engine Company Number 16, located at the corner of Hill and Court Streets. Curator Jim Zordich is looking for photos, reminiscences, and other information from the public on the old warhorse fire engine.



1903 Nott, first spiral tube boiler built for Atlanta, Georgia.

HAT COLLECTION

Josephine Doolittle, wife of General James H. "Thirty Seconds Over Tokyo" Doolittle, has donated her collection of designer hats to the Museum. During World War II, Mrs. Doolittle volunteered in military hospitals on the East Coast. One day, when she was wearing a rather flamboyant feather-covered hat, hospitalized soldiers were so amused that Mrs. Doolittle decided to wear crazy hats regularly. So began a collection that has resulted in the recent gift to the museum of Mrs. Doolittle's 64 best hats. Designers and milliners such as Rose Saphire, Hattie Carnegie, and Howard Hodge are represented in the collection, which has been added to the History Division costume collections.

HISTORIC SITE SURVEY

In October 1977, the History Division staff completed a one-year contract with the State Office of Historic Preservation to survey 500 sites of historical and architectural significance in Los Angeles County. Tom Sitton led this effort, a component of the History Division's program begun in 1974, of identifying county cultural resources. The results of the survey included the establishment of files on all 500 sites, and the nomination of fifteen individual sites and three historic districts for placement on the National Register of Historic Places. Information gathered in the survey is utilized regularly by state and local planners, preservationists, and other researchers.

WPA HISTORICAL RECORDS SURVEY

One of the federal government's public employment programs during the great depression of the 1930s was the Works Progress Administration's study of local historic records. The results of the Southern California Historical Records survey were deposited in the Museum where they have remained in storage. The voluminous paper records of Los Angeles, San Bernardino, Riverside, Orange, and Ventura Counties list the historical holdings of various county departments and agencies.

The Archives section of the History Division, manned by Bill Mason and John Cahoon, is currently describing, cataloguing, labeling and boxing this material which covers nearly fifty linear feet. Since many of the reports exist in multiple copies, duplicates may be made available to appropriate governmental agencies and interested historical research facilities.

TREE FROGS: CHIRPS, PEEPS, AND LOVE SONGS

by Kenneth T. Nemuras

A rich and diverse group of amphibians known as tree frogs flourishes from the humid forests of southern Mexico down through Central America and into the vast South American continent. These belong to the family Hylidae, which includes over forty genera and more than 600 species. Most are nocturnal, hiding by day among palm fronds, plants or in the crevices of trees, and emerging at sundown in noisy choruses of chirps, peeps and insect-like love songs.

Kenneth T. Nemuras enjoys writing about natural history subjects as a hobby. He has traveled widely in Central and South America and writes occasionally about various aspects of amphibian ecology. Other interests include turtles and the biology of tropical cloud forests.

Searching for these clamorous frogs in the tropical rain forests at night can be a fascinating experience, for the endless labyrinth of trails, cascading streams and ponds choked with umbrella-like plants and twisting vines provide harmonious surroundings for a wide diversity of amphibian life. Tropical forests are rich in potential competitors, predators, and prey, and many of these frogs have developed strange methods of survival, taking on bizarre shapes and colors and developing strange modes of reproduction. Some are quite colorful, like *Hyla ebraccata* of Central America (which is mottled yellow and brown), while still others, like *Agalychnis callidryas*, have flashy, red-colored eyes.

TOP
The Rio Vaupes and its tributaries snake through the jungles of Colombia and Brazil en route to the Amazon. *Such "black-water" rivers are relatively free of mosquitoes and bothersome insects, yet often difficult to navigate because of numerous cataracts. Making their home along such river banks, and adjoining streams, is a wide array of amphibian life, including noisy tree frogs, the nocturnal song-makers belonging to the family Hylidae. (Photo: Kenneth T. Nemuras)*

ABOVE LEFT
Agalychnis callidryas. *(Photo: Joseph T. Collins)*

ABOVE RIGHT
Hyla ebraccata, *Panama. Hiding by day among herbaceous plants and jungle foliage, some of these variable tree frogs lack any pattern whatsoever, others are sprinkled casually with flecks or heavily mottled with dark brown. During the mating season, the eggs are usually deposited on the* upper *surfaces of leaves. When the tadpoles later hatch, they wiggle to the edge of the leaf and fall directly to the water below. (Photo: Kenneth T. Nemuras)*

ABOVE
A deadly Bothrops, *draped across a branch, keeps the author on guard. (Photo: Kenneth T. Nemuras)*

ABOVE RIGHT
Snakes, like frogs, abound in the warmness of tropical forests. This one, a Pseudoboa, *is harmless. (Photo: Kenneth T. Nemuras)*

BOTTOM RIGHT
Hyla machadoi *tadpole. Most tree frogs, and other anurans in general, have an aquatic larval stage—the tadpole—which breathes by means of gills. In time the gills and tail will disappear and legs, arms and lungs will replace them for life out of water. (Photo: Ivan Sazima)*

The best time to look for tree frogs is during the rainy season, when they are much more active and romantically inclined. It is then, most often, that the males perch on branches or leaflets and call repeatedly for their mates. An experienced listener can recognize them by their calls alone, since each species has its own distinctive song.

Whenever I set out to search for tree frogs—or *hylids*, as they are often called—I make sure that my backpack contains a lightweight poncho and *two* flashlights in addition to my camera equipment. A spare light of some sort is almost a necessity, for the loss of one's only light source in the darkened forest is an eery feeling, to say the least! Very rarely have I encountered venomous snakes, but just the knowledge that they could be lurking in the underbrush, or dangling from a tree branch, persuades me to move with caution.

Often I'll arrive at a selected site just before dusk, then wait for the darkness to awaken the frogs. One of the first—and loudest—calls that I'll sometimes hear is a resounding "whoop," which doesn't belong to a tree frog at all, but rather to the large "smoky jungle" frog, a member of the genus *Leptodactylus*. These fist-sized frogs, which have glassy eyes, call from on the forest floor near ponds and streams. There are other amphibian voices, too, but once the forest is enveloped by darkness it is the calls of the tree frogs which seem to prevail.

One of the most spectacular of the forest's nocturnal inhabitants, without doubt, is *Agalychnis callidryas*. In Central America I've often pursued these colorful amphibians many times near ponds, along the edges of swamps, or even among patches of cacao trees, and their dazzling appearance has never ceased to amaze me. The call of this tree frog is one that is very pronounced—a sudden *chock...chock, chock* that seems to "snap" through the air. Other tree frog calls vary from the loud drumming sound made by *Hyla faber* to the insect-like "creek-eek-eek" of species like *Hyla phlebodes*, or the repetitious "boop-boop-boop" of *Hyla uranochroa*.

ABOVE LEFT
Hyla uranochroa, *Costa Rica. Its call is a melodic "boop-boop-boop." (Photo: R. Wayne Van Devender)*

ABOVE RIGHT
Mating tree frogs, Hyla phlebodes, *above a jungle pool in Panama. After attracting its mate with an insect-like "creek-eek-eek," the smaller male climbs onto the female's back. Later, the eggs will be deposited in small masses on the surface of a pond. (Photo: Kenneth T. Nemuras)*

BOTTOM LEFT
Tree frog eggs clinging to a leaf. When the tadpoles hatch, they fall directly to the water below. (Photo: Kenneth T. Nemuras)

There are at least eight different species of *Agalychnis,* most of which are prevalent in Middle America. Brightly colored eyes—usually red or yellow—are one of their more prominent features. Their scientific appelation is derived from the Greek word *lychnis,* which is the name of a scarlet-flowered plant.

The females of *Agalychnis callidryas* (appropriately, these are called "red-eyed" tree frogs) are among the frogs that deposit their eggs on leaves, or sometimes vines, hanging above the water. Normally the eggs are attached, in a mass of jelly, to the underside of the leaf. However, if the eggs are laid too close to the pond's shore, as might occasionally happen, then the freeing tadpoles, instead of dropping into the pond, will fall to the ground and die. In contrast to the adults, which are green-skinned, the young, newly-transformed froglets are toned in pink.

Despite their gleaming eyes, the vision of these frogs may leave something to be desired. Some calling males, as a matter of fact, do not take notice of approaching females until they are practically "nose to nose." In his book *The Hylid Frogs of Middle America,* William Duellman noted one female that walked up to her mate, placed a hand on his back, then climbed over him and continued crawling! Once paired, the female will carry the male about on her back, climbing among thorny tree branches and bushes until a suitable spot has been found to deposit the eggs.

Some tree frogs, like the *Hyla phlebodes,* which I have studied in Panama, attach their eggs to floating vegetation. Other amphibians of the rain forest may deposit their eggs on the upper surfaces of leaves above shallow ponds or streams; when the young tadpoles later free themselves, they wiggle to the end of the leaf and then slide off the edge. On the other hand, among frogs belonging to the genus *Gastrotheca,* the eggs are not deposited externally, but instead, develop and hatch within a brood pouch on the female's back. At the proper time the young emerge through a zipper-like opening, either as tadpoles or as tiny, hopping froglets. The name *Gastrotheca* means "stomach pouch," but inasmuch as the rearing of the young takes place on the frog's back, this is presumably a case of mistaken identity by early naturalists.

Abundant amphibians: Twenty of the more than 600 species of the family *Hylidae.*

ABOVE
Hyla faber, *a tree frog that constructs "nests" similar to those of* Hyla boans. *These basin-shaped depressions are fashioned by the male. Task completed, he then lures his spouse with a nocturnal love song. (Photo: Robert S. Simmons)*

ABOVE RIGHT
Nest-building frog, Hyla boans. *(Photo: Kenneth T. Nemuras)*

Another interesting frog, which I encountered along the Rio Vaupes on a journey through Colombia and Brazil, is the nest-building frog, *Hyla boans.* This is one of a few species in which the eggs are deposited in elaborate nests, basin-shaped excavations in the mud or gravel.

How are such "nests" constructed? To begin with, the frog chooses a shallow place along the edge of the water, then circles around in it to form a cavity; this is gradually deepened as mud from the bottom is brought up on the snout and pushed against the rim. Using its hands to pat down the material, the frog strengthens the clay-like wall until its own private pool has taken shape.

Zoologist Ivan Sazima, who has studied the nest-building frog *Hyla faber* in Brazil, told me that generally the males arrive first at the spawning site, then begin calling and building up the mud basins for rearing the eggs. Each male may construct from one to three nests within its territory, into which the female deposits her eggs. The time elapsing between oviposition (egg laying) and hatching is about five to seven days; after this, the tadpoles may remain in the basin another week or two until rising water (or continuous rain) collapses the mud walls.

Sometimes fighting will break out between two males, either in or near the nest. The frogs circle one another, then begin "wrestling" and thrashing about. If the opportunity arises, one opponent may push the other's nostrils beneath the water in an apparent drowning effort.

True to their name, some tree frogs remain aloft in the forest canopy and issue their pulsating tunes from perches that are well out of reach. Others sway on reeds along river banks, or engage in acrobatic maneuvers among the rain-dampened bushes. Since there are more than 600 different species, one could spend a lifetime exploring every facet of behavior of this enormous and widespread family of frogs. Whenever I slip into the forest at night, and the beam from my flashlight disrupts the blanket of darkness and reveals a bright-eyed frog poised on a branch, or a gelatinous mass of eggs clinging to a leaf, the tiny embryos developing into wiggling tadpoles that will slide, one by one, into the water below, I marvel at these splendid songsters that make their home deep in the tropical forest.

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